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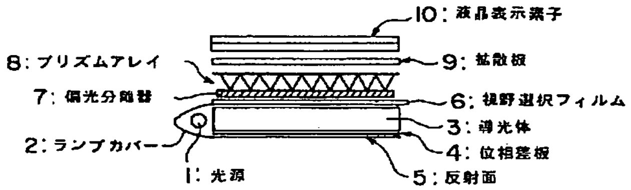
(54)【発明の名称】　照明装置および液晶表示装置

(57)【要約】

【目的】光の利用効率の高い液晶表示装置と、それに適した照明装置を得る。

【構成】光源１と光源に近接配置された面状導光体３とからなる照明装置において、面状導光体３の光出射面側に、所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルム６を配置し、さらに、その上に、偏光分離器７を配置したことを特徴とする照明装置を提供する。



【特許請求の範囲】

【請求項１】光源と光源に近接配置された面状導光体とからなる照明装置において、面状導光体の光出射面側に、所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルムを配置し、さらに、その上に、偏光分離器を配置したことを特徴とする照明装置。

【請求項２】請求項１記載の照明装置において、視野選択フィルムが、４５°から－４５°の角度範囲においてそのヘイズ率が２０％以上の散乱性能を有することを特徴とする照明装置。

【請求項３】請求項１または請求項２記載の照明装置を、照明装置を出射した光線の平均的な偏光軸と液晶表示素子における光入射側の偏光板の偏光軸とが略一致するようにして、液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、液晶テレビ、コンピュータ用液晶ディスプレイ等に用いられる、直線偏光入射光の偏光状態を変調する液晶表示方式を用いた液晶表示素子の背後に設ける平面状照明装置、およびそれを用いた直視型液晶表示装置に関する。

【０００２】

【従来の技術】近年、液晶表示素子、特にカラー表示素子を用いた直視型液晶表示装置の技術進歩は目ざましく、ＣＲＴに劣らぬ表示品位のディスプレイが数多く見られるようになった。白黒表示においては、数年前まで平面照明装置であるバックライトを用いない反射型液晶表示素子が主流であったが、現在は白黒表示においてもほとんどバックライトを用いる透過型液晶表示素子に置き換わっている。また、ノートパソコンが普及段階に入り、バックライト搭載型が市場を席巻するに至った。カラー表示液晶ディスプレイでは、バックライトなしではディスプレイとしての態をなさず、バックライトは直視型液晶表示装置において必須のデバイスとなっている。

【０００３】カラー液晶表示装置は、大別してＴＦＴを用いたアクティブマトリクス駆動によるＴＮ液晶表示装置とマルチプレックス駆動のＳＴＮ液晶表示装置との２方式があり、いずれも液晶層をガラス基板で保持した素子の光入射側および光出射側に偏光板が装着された構成となっていて、直線偏光入射光の偏光状態を変調して液晶表示方式を行うものである。

【０００４】バックライトに要求される輝度レベルはその用途によって様々であるが、特にカラーノートパソコンでは要求輝度だけでなく薄型化・軽量化・省電力化（バッテリー駆動が前提）は至上命題である。

【０００５】平面照明装置を作るには種々の方式があるが、大別して２種に分類される。一般的に最も多い方式は内部照光方式あるいは直下型といわれる方式で、光源が照光面の内側にある方式である。一方、エッジライト型は光源が照光面の外に配置され、照光面である透明なアクリル樹脂板などからなる導光体の一辺もしくは二辺に蛍光ランプ（多くは冷陰極放電管）等の略線状発光体を密着させ、反射体からなるランプカバーを設けて導光体内に光を導入する方式である。

【０００６】カラーノートパソコンでは特に薄型化・軽量化をが要求されるため、エッジライト型バックライトが有効である。エッジライト型バックライトの導光体に求められる必要な機能は、端部より入射した光を前方に送る機能と、送られた光を液晶表示素子側に出射する機能である。前者の機能は使用する材料および界面反射特性に応じて決まり、後者の機能は全反射条件を回避する導光体表面の形状に応じて決まる。この全反射条件を回避する導光体表面の形状に関して、導光体表面に白色の拡散材を形成する方法と導光体表面にレンチキュラーあるいはプリズムのフレネル形状を形成する方法が知られている。

【０００７】

【発明が解決しようとする課題】しかし、内部照光方式およびエッジライト方式いずれの平面照明装置においても、液晶表示素子入射光の偏光方向は不揃いでランダム偏光であるため、ＴＮ型およびＳＴＮ型いずれの液晶素子の場合も表示素子の入射側に装着された偏光板により入射光のうち半分以上が吸収されてしまい光利用効率が低く、結果的に暗い表示画面となってしまった。あるいは、明るくするためには電力消費量が増加してしまうといった問題があった。

【０００８】本発明は、従来技術の前述の欠点の解決を目的とする。

【０００９】

【課題を解決するための手段】本発明は、前述の課題を解決すべくなされたものであり、光源と光源に近接配置された面状導光体とからなる照明装置において、面状導光体の光出射面側に、所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルムを配置し、さらに、その上に、偏光分離器を配置したことを特徴とする照明装置、および、この照明装置を、照明装置を出射した光線の平均的な偏光軸と液晶表示素子における光入射側の偏光板の偏光軸とが略一致するようにして、液晶表示素子の背面に配置したことを特徴とする液晶表示装置を提供する。

【００１０】本発明の照明装置は、偏光分離器の分離性能を高めた構造を有する点に特徴がある。すなわち、偏光分離器には大別して相対的に屈折率の大きな透光性媒質と相対的に屈折率の小さな透光性媒質とを交互に積層してなる多層構造体と光の干渉効果を利用した誘電体膜を板状透光性媒質の上に設けるものがあり、そのいずれもが斜入射光に対してその透過率および反射率が斜入射光の偏光に依存する性質を有する。これにより、非光吸

収型の偏光素子として用いることができる。

【００１１】偏光分離器が相対的に屈折率の大きな透光性媒質と相対的に屈折率の小さな透光性媒質とを交互に積層してなる多層構造体の場合について、さらに説明すると、一般に、屈折率n_0 の光学材料と屈折率n_1 の光学材料との界面において、n_0 からn_1 へと入射する光の入射角θ_{01}が以下の数１のとき、ｐ偏光の反射成分はなく反射光は全てｓ偏光となり、透過光は残りのｓ偏光とｐ偏光であることが知られている。

【００１２】

【数１】$\tan\theta_{01}=n_1/n_0$

【００１３】このとき、入射角θ_{01}をブリュースター角θ_B という。ゆえに、屈折率n_0 ，n_1 の光学材料層を交互に積層した場合、ブリュースター角近傍の入射角光に対してｐ偏光光は透過するがｓ偏光光は複数の界面で反射されて透過光成分はほとんどなくなってしまう。したがって、上記の多層構造体からの出射光は偏光性を有することになる。

【００１４】このような構成により、入射角がブリュースター角近傍の光については、多層構造体を透過したｐ偏光成分は偏光板を透過した後液晶表示素子へ入射し、ｓ偏光成分は面状導光体内へと反射される。この引き戻されたｓ偏光成分は面状導光体の表面で反射を繰り返して導光される際、位相変化が生じ、ｐ偏光成分が生成され、前記多層構造体を透過しうるようになる。したがって、多層構造体で反射されたｓ偏光成分も面状導光体表面で反射を繰り返すにことによってｐ偏光成分に変換される成分が生じ、液晶表示素子へと透過する成分に寄与する。その結果、多層構造体を用い直線偏光光を取り出すことによる光量ロスはわずかで、液晶表示素子への光利用効率の高い直線偏光平面光源として機能する平面状の照明装置が得られる。

【００１５】ブリュースター角は例えば空気とアクリルの組合せからなる多層構造体の場合、約６０°であり、偏光機能は垂直入射光に対しては発現しにくい。

【００１６】偏光分離器としては、面状透光性媒質の少なくとも片方の面に、可視光波長オーダの厚みを有する誘電体膜が少なくとも一層以上成膜されているものを用いることができる。この偏光分離器からの出射光は、高い偏光性を持つ光を出射することになる。

【００１７】偏光分離器の可視光波長オーダの膜厚を有する誘電体膜は光干渉を利用するために、一般に層数が増加すると特定の波長の偏光度を向上させることが出来る反面、波長依存性が大きい。用いるバックライト光源のスペクトルが狭帯波長光の場合は、光のバックライト波長域に対して偏光度が高くなる多層膜構成とすることができる。一方カラー表示用に白色のバックライトを用いる場合は、偏光度の波長依存性を低く抑えるため、５層以下、特に、単層の干渉膜を用いることが好ましい。高い偏光度は得られないが、可視域全域でフラットな偏光度を得るとともに、膜厚制御の容易さから、TiO_2 またはZrO_2 の単層膜を形成することが好ましい。

【００１８】誘電体膜を用いた偏光分離器に用いられる面状透光性媒質の材質は、ガラスやアクリル、ポリカーボネート、ポリウレタン、ポリスチレン等のプラスチックがある。軽い材質であること表面が滑らかであることが望ましい。

【００１９】面状透光性媒質の厚みは可視光波長オーダであってもよいが、面状導光体の片側で保持されなければならないのである程度の剛性が必要である。

【００２０】誘電体膜の材質としては、TiO_2 、ZrO_2 、ZnS、Y_2O_3 、SiO_2、MgF_2 、Na_3AlF_6 、Ta_2O_5 、Ｓｉなどが考えられる。

【００２１】誘電体膜を用いた場合も特にその積層数が少ない場合には偏光機能は４５°以下では発現しにくい。

【００２２】多層構造体の偏光機能は、入射角がブリュースター角のとき、最も有効に作用する。したがって、光源と面状導光体とからなる平面照明装置において多層構造体を配置する場合、光源と面状導光体および光反射手段などのさらに付加された光学素子によって、多層構造体への入射光の入射角がブリュースター角近傍の成分が大半となるような構成とすることが好ましい。

【００２３】この意味で、裏面反射板と表面拡散板との間に蛍光ランプが配置された直下型照明方式よりも、略線状発光体が面状導光体の側部から光入射するように略線状発光体が配置されたいわゆるエッジライト型の方が好ましい。導光体表面に斜入射する成分が大半であるからである。

【００２４】エッジライト型バックライトの導光体からは全反射条件を回避するように導光体表面の形状を選択する。前述のように、この全反射条件を回避する導光体表面の形状に関して、導光体表面に白色の拡散材を形成する方法と導光体表面にレンチキュラーあるいはプリズムのフレネル形状を形成する方法が知られている。

【００２５】しかし、例えば、図３に模式的に示すように、エッジライト型のバックライトからは偏光器の偏光性能を最も良く発揮する６０°付近だけでなく、０°から４５°の成分の光が出射されるためこれを偏光器と組み合わせた場合、偏光器の性能が充分に発揮されないという問題があった。

【００２６】そのため、本発明では、面状導光体の光出射面側に、所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルムを配置し、さらに、その上に、偏光分離器を配置する。

【００２７】所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルムは特開平１－７７００１に示されるような技術によって製造される。すなわち、互いに屈折率差のあるオリゴマーとモノマーまたはモノマー同士からなる組成物を光硬化させ

ることにより得られる。このように生成したシートの硬化物は、屈折率の異なる領域が、ある方向に配向した状態で存在しており、特定の角度より入射した光は、屈折率の異なる領域の境界で全反射し散乱する。その性能は図２に示すように、入射角０°～４５°付近からの光を選択的に散乱させるものである。また、別の態様として、入射角０～４５°の光とともに入射角、例えば７５°以上の光を散乱させる視野角選択フィルムを用いてもよい。

【００２８】これによって、この視野選択フィルムから出射される光の強度の角度分布は偏光器の偏光性能を最も良く発揮する６０°付近が増加するので好ましい。

【００２９】本発明の液晶表示装置において、エッジライト型平面照明装置に適用した場合について、その構成図である図１を用いて以下に詳述する。

【００３０】照光面である透明なアクリル樹脂板導光体３の側面の一辺に導光体側面の長さに対応した発光長を有する蛍光ランプからなる光源１（冷陰極放電管）を密着させ、反射体からなるランプカバー２を設けてランプ出射光を導光体内に導入する。このとき、導光体中を伝搬する光の指向性（角度分布）は、蛍光ランプの配光特性・反射体の集光特性・導光板の伝搬特性等によって決まる。特に、導光体の伝搬特性は前述のように、導光体端部より入射した光を前方に送る機能と、送られた光を所定の方向に出射する機能を兼ね備えたものでなければならない。

【００３１】前者の機能は使用する材料および界面反射特性に応じて決まり、導光体３の液晶表示素子１０側においては導光体３の屈折率によって定まる全反射角θ_c以上の入射角の光が全反射されて導光体３内を伝搬し、全反射角θ_c以下の入射角の光が導光体３の表面で屈折し液晶表示素子１０側に出射される。例えば、空気（ｎ＝１．０）と透明樹脂、例えばアクリル、ポリカーボネート、ポリウレタン、ポリスチレン等のようなプラスチック（ｎは約１．５）の界面における全反射角θ_cは、以下の数２のようになる。

【００３２】

【数２】$\theta_c = \sin^{-1}(1/n) = 41.8°$

【００３３】すなわち出射角が４１．８°以下の入射光が導光体３の照光面より出射することができる。

【００３４】一方、導光体の液晶表示素子と反対の面においては、アルミニウム反射面等の反射面５を形成しておけば反射光は正規反射光として導光体内を導光される。なお、反射面５は導光体３の液晶表示素子１０側面での出射光を増大させるために拡散反射面としてもよい。

【００３５】一方、導光体３への光の入射角が全反射角θ_c以上の場合が大半であると導光体から出射される光がわずかとなってしまうため、全反射条件を回避し導光板３の液晶表示素子１０側に出射させる機能が必要となる。その手段として、導光体３の表面に白色の光拡散材を形成する方法と導光体表面にレンチキュラーあるいはプリズムのフレネル形状（マイクロレンズアレイ、プリズムアレイ等）を形成する方法が知られているが、このような方法では出射光として直線偏光光は得られない。したがって、導光体３の液晶表示面１０側の表面における全反射を回避し、かつ直線偏光のみ液晶表示素子１０側へ取り出す手段として、本発明のように導光体３の表面に配置された偏光分離器７が有効となる。

【００３６】面状導光体３の光出射面側に、所定の角度範囲の入射光を散乱し、それ以外の角度の入射光を透過させる視野選択フィルム６を配置する。視野選択フィルム６は図２に示すようなヘイズ率の入射角依存性を示す。

【００３７】視野選択フィルム６は、４５°～－４５°の角度範囲においてそのヘイズ率が２０％以上の散乱性能を有する。

【００３８】透明なアクリル樹脂板の導光体３の照光面側に前述のように偏平な気泡層が層状に分散されたような多層構造体である偏光分離器７を形成した場合、数１からアクリル樹脂と気泡層との界面でのブリュースター角θ_Bは３３．７°となる。したがって、アクリル樹脂側からの多層構造体への入射光が３３．７°近傍になるように蛍光ランプの配光特性・反射体の集光特性・導光板の伝搬特性等を最適化することにより、ｐ偏光のみが液晶表示素子側に出射される。一方、ｓ偏光は全反射されたのと同様に導光体３中を伝搬することになる。なお、この多層構造体である偏光分離器６による偏光特性は入射光がブリュースター角条件から少々ずれても充分発現する効果であり、この場合２０°から全反射角近傍である４０°の入射光に対しても、ｓ，ｐ偏光の消光比が若干劣化するが、偏光作用は顕著である。

【００３９】薄型化・軽量化の要請から、平面照明装置の構成に制約があり、アクリル樹脂板導光体内を伝搬する光の多層構造体への入射角θが、の構成ではブリュースター角近傍の値になりえず全反射してしまう（$\theta > \theta_c = 41.8°$）場合は、導光体３の液晶表示素子１０と反対側面に形成された反射面を拡散反射面とするかあるいはプリズムアレイのような微細傾斜反射面を形成することにより、この面での反射後の多層構造体である偏光分離器７の面への入射角度がブリュースター角近傍となるような偏向板の機能を持たせればよい。あるいは、導光体３の液晶表示素子１０側の多層構造体である偏光分離器７の形成される面をプリズムアレイのような微細傾斜透過面とし、その上に多層構造体を形成することにより相対的に多層構造体への入射角をブリュースター角近傍にすることも可能である。

【００４０】エッジライト型バックライトにおいて、上述のように導光体を伝搬し多層構造体を出射した光の指向性は、液晶表示素子の観測者の視野角すなわち液晶表

示素子面の垂直方向に分布しているとは限らない。むしろ、多層構造体にブリュースター角近傍の入射角で入射した光の出射方向は、導光体中を伝搬する光の光軸を含む面内で、液晶表示素子面の垂直方向に対して－４０°～－７０°と４０°～７０°との片寄った視野角域の範囲に集中し、観測者の視野角域に到達する光はわずかで、明るい表示とはいえない。

【００４１】図１において、アクリル樹脂側からの多層構造体である偏光分離器への入射光が３３．７°の場合、多層構造体である偏光分離器からの出射角はｓｉｎ$^{-1}$（（ｓｉｎ３３．７°）／ｎ）＝５６．３°となる。このように、片寄った視野角域（±４０°～±７０°）に配光分布を有する平面照明装置の配光分布を照光面の垂直方向に変換する場合、レンチキュラーあるいはプリズムのフレネル形状（マイクロレンズアレイ、プリズムアレイ等）を形成することが有効である。

【００４２】図１には多層構造体の形成された導光体と液晶表示素子の光入射側の偏光板との間にプリズムアレイ８を導光体３中を伝搬する光の光軸方向に並列に配置した場合が示されている。すなわち、この場合、面状導光体内を出射する光線の平均的光軸を含む面での断面が三角形状の柱状プリズムをアレイ状に配置している。プリズムアレイの作用はその形状および配置（プリズム頂角を光入射側にするか光出射側にするか）に応じて、プリズムの入射面と出射面で屈折が生じるのみの場合と他の面で全反射が起こる場合とがあり、最終的に必要とする配光分布方位と多層構造体出射光の配光分布方位とから最適な形状が決定される。

【００４３】図１では、断面形状が頂角５８°の２等辺三角形のプリズムアレイを用い、頂角が多層構造体面に面するように配置している。このようなプリズムアレイを用いることにより、多層構造体から５６°近傍の出射角で透過してきた光はプリズム側面から入射し他の側面で全反射した後プリズム底面から液晶表示素子側に垂直入射方向に対応して出射される。したがって、このようなプリズムアレイを用いることにより、多層構造体から５６°近傍の出射角で放出される光の配光方位を液晶表示素子面に垂直方向の配光方位に変換することができる。

【００４４】このようにして、液晶表示素子を垂直配光方位で照光する直線偏光平面照明装置が得られる。導光体中を伝搬する光の指向性が高く、結果的に平面照明装置から出射される光の配光方位分布が垂直方向に集中し、明るい表示に対応した視野角の範囲が狭くなる場合がある。このようなときには、液晶表示素子と上述のプリズムアレイ等の偏向手段との間に、指向性を劣化させる拡散板９等の光学素子を配置することができる。

【００４５】また、導光体内を伝搬する光の指向性を劣化させるために、導光体の液晶表示素子と反対側面に形成された反射面５を拡散面としてもよい。また、多層構造体自体をその構造体界面で光散乱も生じるように微細な凹凸構造を有するものとしてもよい。前述のように均質なプラスチック中に偏平な気泡層が層状にに分散されたような構成の場合では、気泡層の界面形状はランダムであり微細な凹凸構造が生じやすいため、光拡散効果も同時に発現しやすい。

【００４６】本発明において直線偏光光を効率良く平面平面照明装置から得るためには、多層構造体において反射され導光体内に引き戻されたｓ偏光成分を、導光体内を伝搬中に効率良くｐ偏光光に変換し再利用することが重要である。このｓ偏光光をｐ偏光光に変換する方法は種々存在するが、以下に代表例を記す。

【００４７】一般に、金属面に直線偏光光が斜入射し反射された場合、直線偏光光は金属の光学物性定数（屈折率ｎ、吸収係数ｋ）に応じて楕円偏光光となることが知られている。すなわち、ｓ偏光光が入射しても反射光にはｐ偏光成分が生成される。したがって、本発明において導光体３の液晶表示素子１０と反対側の面に形成された反射面５がアルミニウム等の金属である場合、この反射面で反射されるたびにｓ偏光光の一部がｐ偏光光に変換される。

【００４８】別な方法として、偏光軸方向を回転させる素子として透光性高分子材料からなる位相差板が知られている。適当な膜厚を有するこの位相差板４を導光体３の反射面５と偏光分離器６との間に配置することにより、偏光分離器により反射されたｓ偏光光は楕円偏光になりその一部をｐ偏光光に変換することができる。図１は、この位相差板４を導光体３に設けた反射面５上に密着させて効率よく偏光変換を行う構成例を示す。

【００４９】以上、エッジライト型平面照明装置を用いた液晶表示装置に関して本発明を説明したが、液晶表示装置の照明としては、本発明はエッジライト型に限らず液晶表示背面の照光面下に蛍光ランプが設置された直下型平面照明装置においても適用されうる。

【００５０】また、以上の説明では導光体に使用する透明樹脂としてアクリルを用いた場合を記したが、ポリカーボネート、ポリウレタン、ポリスチレン、シリコーン等でもよい。

【００５１】

【実施例】

［実施例１］図１を参照しながら、本発明の実施例について説明する。照光面である透明なアクリル樹脂板導光体３の一辺に蛍光ランプからなる光源１（冷陰極放電管）を密着させ、反射体からなるランプカバー２を設けて導光体内に光を導入しするエッジライト型バックライトにおいて多層構造体である偏光分離器７を組み合わせた。

【００５２】光源１としては、１０インチ液晶表示面の側面長（１５２ｍｍ）に対応した長さを有し管径の細い１０Ｗとの冷陰極放電管を使用した。また、ランプカバ

ー２としては、冷陰極放電管を包み込むような円筒形あるいは楕円筒形の反射鏡を、導光体３としては、アクリル樹脂製の透光性導光板（ｎ＝１．５）で大きさは１６０ｍｍ×２２０ｍｍ×５ｍｍのものを用いた。

【００５３】さらに、導光体３の裏面および蛍光ランプ設置面に対向する導光体側面に位相差板４を設け、その上にアルミニウム金属反射膜からなる反射面を形成した。

【００５４】視野選択フィルム６はポリエーテルウレタンアクリレート（屈折率１．４８１）とトリブロモフェノキシエチルアクリレート（屈折率１．５６７）と光重合開始剤との混合物に紫外線を照射して作成した。このフィルムを導光体３の上に設置した。このフィルムはほぼ図２のような視野角依存性を持つものであった。

【００５５】偏光分離器７としては、均質な透明プラスチック板（ｎ＝１．５）中に、その厚さ方向の高さが１０μｍ程度で半径数ｍｍ程度の偏平な気泡層が約５層位層状に分散された構成を採用して、視野選択フィルム６の光出射面側に装着した。

【００５６】また、プリズムアレイ８として、断面形状が頂角５８°の２等辺三角形のプリズムアレイを用い、頂角が偏光分離器７に面するように配置した。プリズムアレイ板の厚さは２ｍｍでプリズムアレイのピッチは約１ｍｍとした。さらに、プリズムアレイ７の光出射面側には、拡散板９を、視野角を広げるために用いた。

【００５７】液晶セル１０としては、ＴＦＴ駆動のＴＮ液晶であって、ＶＧＡ対応画素数を有するＲＧＢカラーＴＦＴ駆動ＴＮ液晶表示セルを用いた。

【００５８】本発明の照明装置の出射光の偏光軸と偏光板の偏光軸とを略一致させた。出射側偏光板も同様に光吸収型有機偏光板を用いた。偏光軸の向きは表示モード（ノーマリホワイト、ノーマリブラック）によって適宜選ばれるが、本実施例では、ノーマリホワイト表示とし、入射側面の偏光板の偏光軸に対して９０°偏光軸が回転した方向に出射側面の偏光板の偏光軸をとった。光源には１０Ｗの蛍光ランプを使用した。

【００５９】比較例として、実施例と同様であって、視野選択フィルムを使用しない場合を行った結果、実施例の方が比較例よりも１．２倍大きかった。

【００６０】［実施例２］偏向分離器７として、実施例１のものに代えて均質なガラス基板（ｎ＝１．５２）の両表面に、酸化チタン（$\mathrm{TiO_2}$：ｎ＝２．３５）膜を一層形成したものを用いたが、実施例１と同様に明るい照明装置が得られた。

【００６１】

【発明の効果】本発明により、光の利用効率の高い液晶表示装置と、それに適した照明装置が得られる。

【図面の簡単な説明】

【図１】本発明の実施例を示した断面図

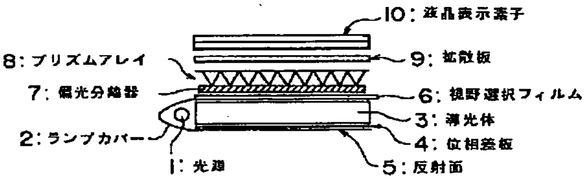
【図２】視野角選択フィルムの視野角依存性を示すグラフ

【図３】従来のエッジライト型バックライトの出射光の角度分布を示すグラフ

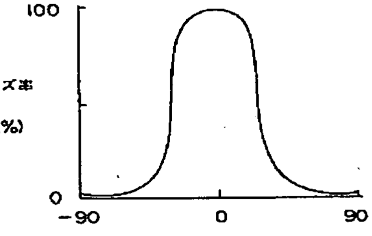
【符号の説明】

１：蛍光ランプからなる光源
２：ランプカバー
３：導光体
４：位相差板
５：反射面
６：視野選択フィルム
７：偏光分離器
８：プリズムアレイ
９：拡散板
１０：液晶表示素子

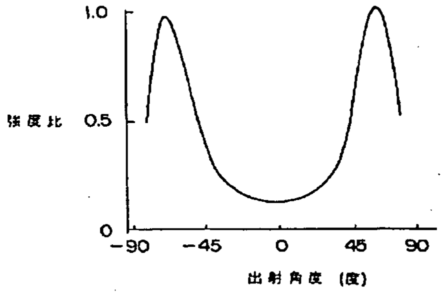
【図１】



【図２】



【図３】



PATENT ABSTRACTS OF JAPAN

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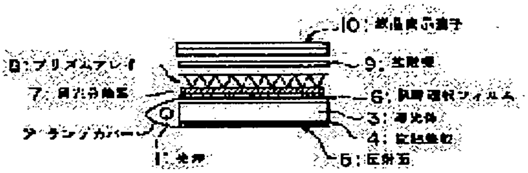
(72)Inventor : KORISHIMA TOMONORI
OI YOSHIHARU

(54) ILLUMINATOR AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PURPOSE: To obtain a liquid crystal display device having a high efficiency for utilizing light and an illuminator suitable therefor.

CONSTITUTION: In an illuminator constituted of a light source 1 and a surface light transmission body 3 that is arranged in the proximity of the light source, a visual field selecting film 6 is arranged, by which an incident light within a prescribed angle range is scattered and an incident light of other angles is transmitted, on the light emitting side of the surface light transmission body 3; and also on top of it, a polarized light separator 7 is arranged, as the characteristic of the illuminator.



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[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The lighting system characterized by having scattered the incident light of the predetermined include-angle range on the optical outgoing radiation side side of a field-like transparent material, having arranged the visual field selection film which makes the incident light of the other include angle penetrate in the lighting system which becomes the light source and the light source from the field-like transparent material by which contiguity arrangement was carried out, and having arranged the polarization eliminator on it further.

[Claim 2] The lighting system with which a visual field selection film is characterized by the rate of haze having 20% or more of dispersion engine performance in the include-angle range of 45 to -45 degrees in a lighting system according to claim 1.

[Claim 3] The liquid crystal display characterized by having arranged the lighting system according to claim 1 or 2 for the lighting system at the tooth back of a liquid crystal display component as the average polarization shaft of the beam of light which carried out outgoing radiation, and the polarization shaft of the polarizing plate by the side of the optical incidence in a liquid crystal display component carried out abbreviation coincidence.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the plane lighting system formed behind the liquid crystal display component using the liquid crystal display method which is used for a liquid crystal television, the liquid crystal display for computers, etc., and which modulates the polarization condition of linearly polarized light incident light, and the direct viewing type liquid crystal display using it.

[0002]

[Description of the Prior Art] In recent years, many displays of display grace in which the technical progress of the direct viewing type liquid crystal display using a liquid crystal display component, especially a color display component is not inferior to **** better ** and CRT came to be seen. In monochrome display, although the reflective mold liquid crystal display component which does not use the back light which is a flat-surface lighting system before several years was in use, current is replaced with the transparency mold liquid crystal display component using a back light for almost also in monochrome display. Moreover, a notebook computer goes into a spread phase and the back light loading mold came to overwhelm the commercial scene. In the color display liquid crystal display, voice as a display is not made without a back light, but the back light serves as an indispensable device in the direct viewing type liquid crystal display.

[0003] A color liquid crystal display is divided roughly, has two methods of the TN liquid crystal display and the STN liquid crystal display of a multiplexer drive by the active-matrix drive using TFT, has the composition that the optical optical incidence [of the component for which all held the liquid crystal layer with the glass substrate], and outgoing radiation side was equipped with the polarizing plate, modulates the polarization condition of linearly polarized light incident light, and holds a liquid crystal display method.

[0004] Although the intensity level required of a back light varies with the application, in a color notebook computer, especially not only demand brightness but thin-shape-izing, lightweight-izing, and power-saving (a dc-battery drive is a premise) are a supreme proposition.

[0005] Although there are various methods in making a flat-surface lighting system, it divides roughly and is classified into two sorts. General most methods are methods called a Terumitsu Uchibe method or direct female mold, and are methods which have the light source inside an illumination side. On the other hand, an edge light mold is a method which the light source is arranged outside an illumination side, and is made to stick approximate line-like illuminants, such as a fluorescent lamp (for many to be cold cathode discharge tubes), to one side of the transparent material which consists of a transparent acrylic resin plate which is an illumination side, or two sides, prepares the lamp cover which consists of a reflector, and introduces light in a transparent material.

[0006] Since it ****** thin-shape-izing and lightweight-ization especially in a color notebook computer, an edge light mold back light is effective. The required functions for which the transparent material of an edge light mold back light is asked are the function to send ahead the light which carried out incidence from the edge, and a function which carries out outgoing radiation of the sent light to a liquid crystal display component side. The former function is decided according to the ingredient and interface reflection property to be used, and the latter function is decided according to the configuration on the front face of a transparent material of avoiding total reflection conditions. The approach of forming a white dispersing agent in a transparent material front face and the approach of forming a lenticular sheet or the Fresnel configuration of prism in a transparent material front face are learned about the configuration on the front face of a transparent material of avoiding this total reflection condition.

[0007]

[Problem(s) to be Solved by the Invention] however, an internal illumination method and an edge light method -- since the polarization direction of liquid crystal display component incident light is irregular and it is random polarization also in which flat-surface lighting system -- TN mold and a STN mold -- more than one half will be absorbed among incident light with the polarizing plate with which the incidence side of a display device was equipped, in [any] a liquid crystal device, efficiency for light utilization is low, and it serves as the display screen dark as a result. Or in order to make it bright, there was a problem that power consumption will increase.

[0008] This invention aims at solution of the above-mentioned fault of the conventional technique.

[0009]

[Means for Solving the Problem] In the lighting system which this invention is made that the above-mentioned technical problem should be solved, and becomes the light source and the light source from the field-like transparent material by which contiguity arrangement was carried out The incident light of the predetermined include-angle range is scattered on the optical outgoing radiation side side of a field-like transparent material, and the visual field selection film which makes the incident light of the other include angle penetrate is arranged. Furthermore, the average polarization shaft of the beam of light which carried out outgoing radiation, and the polarization shaft of the polarizing plate by the side of the optical incidence in a liquid crystal display component are made to carry out abbreviation coincidence of the lighting system characterized by having arranged the polarization eliminator on it, and this lighting system for a lighting system. The liquid crystal display characterized by having arranged at the tooth back of a liquid crystal display component is offered.

[0010] The lighting system of this invention has the description in the point of having the structure which raised the separability ability of a polarization eliminator. namely, the thing which prepares the dielectric film using the multilayer-structure object which divides roughly into a polarization eliminator and comes to carry out the laminating of the translucency medium with a small refractive index by turns relatively [medium / with a big refractive index / translucency] relatively, and the cross protection of light on a tabular translucency medium -- it is -- the any -- although -- it has the property for which the permeability and reflection factor depend on polarization of oblique incidence light to oblique incidence light. Thereby, it can use as a polarizing element of a non-light absorption mold.

[0011] About the case of the multilayer-structure object with which a polarization eliminator comes to carry out the laminating of the translucency medium with a small refractive index by turns relatively [medium / with a big refractive index / translucency] relatively, if it explains further general -- refractive index n0 An optical material and refractive index n1 an interface with an optical material -- setting -- n0 from -- n1 When the incident angle theta 01 of the light which carries out incidence is following several 1, there is no reflective component of p-polarized light, all the reflected lights turn into s-polarized light, and it is known that the transmitted light is remaining s-polarized light and p-polarized light.

[0012]

[Equation 1] tantheta01=n1 / n0 [0013] At this time, it is brewster's-angle thetaB about an angle of incidence theta 01. It says. Therefore, a refractive index n0 and n1 When the laminating of the optical material layer is carried out by turns, although p-polarized light light penetrates to the incident angle light near the brewster's angle, s-polarized light light will be reflected by two or more interfaces, and most transmitted light components will be lost. Therefore, the outgoing radiation light from the above-mentioned multilayer-structure object will have polarizability.

[0014] By such configuration, an angle of incidence carries out incidence of the p-polarized light component which penetrated the multilayer-structure object about the light near the brewster's angle to a liquid crystal display component, after penetrating a polarizing plate, and an s-polarized light component is reflected into a field-like transparent material. In case this s-polarized light component pulled back repeats reflection and a light guide is carried out on the front face of a field-like transparent material, a phase change arises, a p-polarized light component is generated, and it may come to penetrate said multilayer-structure object. Therefore, the component changed into a p-polarized light component by things repeating reflection on a field-like transparent material front face arises, and the s-polarized light component reflected with the multilayer-structure object also contributes to the component penetrated to a liquid crystal display component. Consequently, the quantity of light losses by taking out linearly polarized light light using a multilayer-structure object are few, and the plane lighting system which functions as the linearly polarized light flat-surface light source with the high efficiency for light utilization to a liquid crystal display component is obtained.

[0015] In the case of the multilayer-structure object which consists of combination of air and an acrylic, a brewster's angle is about 60 degrees, and it is hard to discover a polarization function to vertical-incidence light.

[0016] That by which the dielectric film which has the thickness of light wavelength order in the field of at least one of the two of a field-like translucency medium is further formed at least above as a polarization eliminator can be used. The outgoing radiation light from this polarization eliminator will carry out outgoing radiation of the light with high polarizability.

[0017] While the dielectric film which has the thickness of the light wavelength order of a polarization eliminator can raise the degree of polarization of specific wavelength if a number of layers generally increases in order to use an optical interference, its wavelength dependency is large. When the spectrum of the back light light source to be used is **** wavelength light, it can consider as the multilayers configuration to which degree of polarization becomes high to the back light wavelength region of light. When using a white back light for color displays, in order to, suppress the wavelength dependency of degree of polarization low on the other hand, it is desirable to use the interference film of a monolayer especially five or less layers. High degree of polarization is the ease of thickness control to TiO2 while obtaining flat degree of polarization throughout a visible region, although not obtained. Or ZrO2 It is desirable to form monolayer.

[0018] The quality of the material of the field-like translucency medium used for the polarization eliminator using a dielectric film has plastics, such as glass, an acrylic, a polycarbonate, polyurethane, and polystyrene. It is desirable for a being [it / the light quality of the material] front face to be smooth.

[0019] Although the thickness of a field-like translucency medium may be light wavelength order, since it must be held at one side of a field-like transparent material, a certain amount of rigidity is required.

[0020] As the quality of the material of a dielectric film, TiO2, ZrO2, ZnS, Y2 O3, SiO2 and MgF2, Na3 AlF6, Ta 2O5, Si, etc. can be considered.

[0021] When a dielectric film is used, and there are few especially the laminatings, at 45 degrees or less, it is hard to discover a polarization function.

[0022] The polarization function of a multilayer-structure object acts most effectively, when an angle of incidence is a brewster's angle. Therefore, when arranging a multilayer-structure object in the flat-surface lighting system which consists of the light source and a field-like transparent material, it is desirable to consider as a configuration in which the angle of incidence of the incident light to a multilayer-structure object becomes most [the component near the brewster's angle] by the optical element added to pans, such as the light source, a field-like transparent material, and a light reflex means.

[0023] The so-called edge light type with which the approximate line-like emitter has been arranged so that an approximate line-like emitter may carry out optical incidence from the flank of a field-like transparent material of direction is more desirable than the direct female mold lighting method with which the fluorescent lamp has been arranged between a rear-face reflecting plate and a surface diffusion plate in this semantics. It is because the component which carries out oblique incidence to a transparent material front face is most.

[0024] The configuration on the front face of a transparent material is chosen from the transparent material of an edge light mold back light so that total reflection conditions may be avoided. As mentioned above, the approach of forming a white dispersing agent in a transparent material front face and the approach of forming a lenticular sheet or the Fresnel configuration of prism in a transparent material front face are learned about the configuration on the front face of a transparent material of avoiding this total reflection condition.

[0025] However, from the back light of an edge light mold, as typically shown in drawing 3 for example, since outgoing radiation of the light of not only near 60 degree but a 0 to 45 degrees component which demonstrates the polarizability of a polariscope best was carried out, when this was combined with a polariscope, there was a problem that the engine performance of a polariscope was not fully demonstrated.

[0026] Therefore, in this invention, the incident light of the predetermined include-angle range is scattered on the optical outgoing radiation side side of a field-like transparent material, the visual field selection film which makes the incident light of the other include angle penetrate is arranged, and a polarization eliminator is further arranged on it.

[0027] The incident light of the predetermined include-angle range is scattered about, and the visual field selection film which makes the incident light of the other include angle penetrate is manufactured by the technique as shown in JP,1-77001,A. That is, it is obtained by carrying out photo-curing of the constituent which consists of the oligomer, monomer, or monomers which has a refractive-index difference mutually. Thus, the field where the hardened materials of the generated sheet differ in a refractive index carries out total reflection of the light which existed where orientation is carried out in a certain direction, and carried out incidence from the specific include angle on the boundary of the field where refractive indexes differ, and it is scattered about. The engine performance scatters alternatively the light from near 0 degree - 45 degrees of incident angles, as shown in drawing 2 . Moreover, the angle-of-visibility selection film over which an incident angle, for example, light 75 degrees or more, is scattered with the light of 0-45 degrees of incident angles may be used as another mode.

[0028] Since near 60 degree which demonstrates the polarizability of a polariscope best increases, the angular distribution of the luminous intensity in which outgoing radiation is carried out from this visual field selection film by this is desirable.

[0029] In the liquid crystal display of this invention, the case where it applies to an edge light mold flat-surface lighting system is explained in full detail below using drawing 1 which is the block diagram.

[0030] The light source 1 (cold cathode discharge tube) which becomes one side of the side face of the transparent acrylic resin plate transparent material 3 which is an illumination side from the fluorescent lamp which has the luminescence length corresponding to the die length of a transparent material side face is stuck, the lamp cover 2 which consists of a reflector is formed, and lamp outgoing radiation light is introduced in a transparent material. At this time, the directivity (angular distribution) of the light which spreads the inside of a transparent material is decided by the propagation property of the condensing property and light guide plate of the luminous-intensity-distribution property and reflector of a fluorescent lamp etc. If especially the propagation property of a transparent material is not what combines the function to send ahead the light which carried out incidence from the transparent material edge as mentioned above, and the function which carries out outgoing radiation of the sent light in the predetermined direction, it will not become.

[0031] The former function is total reflection angle thetac which is decided according to the ingredient and interface reflection property to be used, and becomes settled with the refractive index of a transparent material 3 in the liquid crystal display component 10 side of a transparent material 3. Total reflection of the light of the above incident angle is carried out, the inside of a transparent material 3 is spread, and it is total reflection angle thetac. The light of the following incident angles is refracted on the front face of a transparent material 3, and outgoing radiation is carried out to the liquid crystal display component 10 side. For example, total reflection angle thetac in the interface of plastics (n is about 1.5), such as air (n= 1.0), transparence resin, for example, an acrylic, a polycarbonate, polyurethane, and polystyrene, It becomes like following several 2.

[0032]

[Equation 2] thetac =sin-1(1/n) =41.8 degree[0033] That is, the incident light of 41.8 or less degrees can carry out [an outgoing radiation angle] outgoing radiation from the illumination side of a transparent material 3.

[0034] On the other hand, in a field opposite to the liquid crystal display component of a transparent material, if the reflector 5 of an aluminum reflector etc. is formed, the light guide of the reflected light will be carried out in the inside of a transparent material as the normal reflected light. In addition, a reflector 5 is good also as a diffuse reflector in order to increase the outgoing radiation light in liquid crystal display component 10 side face of a transparent material 3.

[0035] On the other hand, the incident angle of the light to a transparent material 3 is total reflection angle thetac. Since the light by which outgoing radiation is carried out to the case where it is above being most from a transparent material becomes small, the function which avoids total reflection conditions and carries out outgoing radiation to the liquid crystal display component 10 side of a light guide plate 3 is needed. Although the approach of forming an optical white dispersing agent in the front face of a transparent material 3 and the approach of forming a lenticular sheet or the Fresnel configurations (a micro-lens array, prism array, etc.) of prism in a transparent material front face are learned as the means, by such approach, linearly polarized light light is not obtained as an outgoing radiation light. Therefore, the polarization eliminator 7 arranged on the front face of a transparent material 3 like this invention as a means which avoids the total reflection in the front face by the side of the liquid crystal display side 10 of a transparent material 3, and takes out only the linearly polarized light to the liquid crystal display component 10 side becomes effective.

[0036] The incident light of the predetermined include-angle range is scattered on the optical outgoing radiation side side of the field-like transparent material 3, and the visual field selection film 6 which makes the incident light of the other include angle penetrate is arranged. The visual field selection film 6 shows the incident angle dependency of the rate of haze as shown in drawing 2 .

[0037] In the include-angle range of 45 degrees - -45 degrees, as for the visual field selection film 6, the rate of haze has 20% or more of dispersion engine performance.

[0038] When the polarization eliminator 7 which is the multilayer-structure object with which the cellular layer flat as mentioned above was distributed in the shape of a layer at the illumination side side of the transparent material 3 of a transparent acrylic resin plate is formed, it is brewster's-angle thetaB in the interface of several 1 to acrylic resin, and a cellular layer. It becomes 33.7 ″. Therefore, outgoing radiation only of the p-polarized light is carried out to a liquid crystal display component side by optimizing the propagation property of the condensing property and light guide plate of the luminous-intensity-distribution property and reflector of a fluorescent lamp etc. so that the incident light to the multilayer-structure object from an acrylic resin side may become near 33.7″. On the other hand, s-polarized light will spread the inside of a transparent material 3 the same with total reflection having been carried out. In addition, polarization is remarkable although the polarization property by the polarization eliminator 6 which is this multilayer-structure object is effectiveness discovered enough even if incident light shifts from brewster's-angle conditions a little, and the extinction ratio of s and p-polarized light deteriorates from 20 degrees a little also to the 40-degree incident light which it is near the total reflection angle in this case.

[0039] The incident angle theta to the multilayer-structure object of the light which the configuration of a flat-surface lighting system has constraint, and spreads the inside of an acrylic resin plate transparent material from the request of thin-shape-izing and lightweight-izing When it cannot become a value near the brewster's angle and carries out total reflection to it in ****** (c = 41.8 ″ theta>theta) By making into a diffuse reflector the reflector formed in the liquid crystal display component 10 and opposite side side of a transparent material 3, or forming a detailed inclination reflector like a prism array What is necessary is just to give the function of a deflecting plate in which whenever [to the field of the polarization eliminator 7 which is a multilayer-structure object after reflection in this field / angle-of-incidence] becomes near the brewster's angle. Or it is also possible to make into a detailed inclination transparency side like a prism array the field in which the polarization eliminator 7 which is a multilayer-structure object by the side of the liquid crystal display component 10 of a transparent material 3 is formed, and to carry out the angle of incidence to a multilayer-structure object near the brewster's angle relatively by forming a multilayer-structure object on it.

[0040] In an edge light mold back light, the directivity of the light which spread the transparent material as mentioned above and carried out outgoing radiation of the multilayer-structure object is not necessarily distributed over the angle of visibility of the watcher of a liquid crystal display component, i.e., the perpendicular direction of a liquid crystal display component side. The direction of outgoing radiation of the light which carried out incidence to the multilayer-structure object by the incident angle near the brewster's angle is rather concentrated on the range of the partial angle-of-visibility region (-40 degrees - -70 degrees and 40 degrees - 70 degrees) to the perpendicular direction of a liquid crystal display component side in a field including the optical axis of the light which spreads the inside of a transparent material, and the light which arrives at a watcher's angle-of-visibility region is slight, and cannot say it as a bright display.

[0041] In drawing 1 , when the incident light to the polarization eliminator which is a multilayer-structure object from an acrylic resin side is 33.7 ", the outgoing radiation angle from the polarization eliminator which is a multilayer-structure object serves as sin-1(33.7 " sin) (/n) =56.3". Thus, when changing into the perpendicular direction of an illumination side luminous-intensity-distribution distribution of the flat-surface lighting system which has luminous-intensity-distribution distribution in the partial angle-of-visibility region (**40 degrees - **70 degrees), it is effective to form a lenticular sheet or the Fresnel configurations (a micro-lens array, prism array, etc.) of prism.

[0042] The case where the inside of a transparent material 3 has been arranged to juxtaposition in the direction of an optical axis of the light to spread is shown in the prism array 8 at drawing 1 between the transparent material in which the multilayer-structure object was formed, and the polarizing plate by the side of the optical incidence of a liquid crystal display component. That is, the cross section in a field including the average optical axis of the beam of light which carries out outgoing radiation of the inside of a field-like transparent material in this case arranges pillar-shaped triangle-like prism in the shape of an array. The optimal configuration is determined from luminous-intensity-distribution distribution bearing and luminous-intensity-distribution distribution bearing of multilayer-structure object outgoing radiation light which total reflection may happen in respect of the case of only refraction arising in respect of the plane of incidence of prism, and outgoing radiation, and others, and finally need an operation of a prism array according to the configuration and arrangement (do you make a prism vertical angle into an optical incidence side, or turn on an optical outgoing radiation side?).

[0043] In drawing 1 , using the prism array of two equilateral triangles whose cross-section configurations are 58 degrees of vertical angles, it arranges so that a vertical angle may face multilayer-structure dignity. By using such a prism array, after it carries out incidence of the light penetrated on the about 56-degree outgoing radiation square from the multilayer-structure object from a prism side face and it carries out total reflection on other side faces, corresponding to the direction of vertical incidence, outgoing radiation of it is carried out to a liquid crystal display component side from a prism base. Therefore, luminous-intensity-distribution bearing of the light emitted on an about 56-degree outgoing radiation square is convertible for a liquid crystal display component side in the vertical luminous-intensity-distribution bearing from a multilayer-structure object by using such a prism array.

[0044] Thus, the linearly polarized light flat-surface lighting system which illuminates a liquid crystal display component in the perpendicular luminous-intensity-distribution bearing is obtained. The directivity of the light which spreads the inside of a transparent material is high, luminous-intensity-distribution bearing distribution of the light by which outgoing radiation is carried out as a result from a flat-surface lighting system may concentrate perpendicularly, and the range of the angle of visibility corresponding to a bright display may become narrow. When such, the optical element of the diffusion plate 9 grade which degrades directivity between a liquid crystal display component and deflection means, such as an above-mentioned prism array, can be arranged.

[0045] Moreover, in order to degrade the directivity of the light which spreads the inside of a transparent material, it is good also considering the reflector 5 formed in the liquid crystal display component and opposite side side of a transparent material as the diffusing surface. Moreover, it is good also as what has detailed concavo-convex structure so that light scattering may also produce the multilayer-structure object itself in the structure interface. in the case of a configuration [as the cellular layer flat in plastics homogeneous as mentioned above was alike in the shape of a layer and was distributed], since it is easy to produce random and detailed concavo-convex structure, the interface configuration of a cellular layer also tends to discover an optical spreading effect to coincidence.

[0046] In order to obtain linearly polarized light light from a flat-surface flat-surface lighting system efficiently in this invention, it is important to change efficiently [while spreading the inside of a transparent material] into p-polarized light light the s-polarized light component which was reflected in the multilayer-structure object and pulled back in the transparent material, and to reuse it. Although various methods of changing this s-polarized light light into p-polarized light light exist, the example of representation is described below.

[0047] Generally, when linearly polarized light light carries out oblique incidence to a metal side and is reflected in it, it is known that linearly polarized light light will turn into elliptically-polarized-light light according to a metaled optical physical property value (a refractive index n, an absorption coefficient k). That is, even if s-polarized light light carries out incidence, a p-polarized light component is generated by the reflected light. Therefore, when the reflectors 5 formed in the liquid crystal display component 10 of a transparent material 3 and the field of the opposite side in this invention are metals, such as aluminum, whenever it is reflected in this reflector, a part of s-polarized light light is changed into p-polarized light light.

[0048] The phase contrast plate which consists of translucency polymeric materials as another approach as a component which rotates polarization shaft orientations is known. By arranging this phase contrast plate 4 that has suitable thickness between the reflector 5 of a transparent material 3, and the polarization eliminator 6, the s-polarized light light reflected by the polarization eliminator turns into elliptically polarized light, and can change that part into p-polarized light light. Drawing 1 shows the example of a configuration which is made to stick this phase contrast plate 4 on the reflector 5 established in the transparent material 3, and performs polarization conversion efficiently.

[0049] As mentioned above, although this invention was explained about the liquid crystal display using an edge light mold flat-surface lighting system, as lighting of a liquid crystal display, this invention is applied also in the direct female mold flat-surface lighting system with which the fluorescent lamp was installed in the bottom of the illumination side not only on an edge light mold but the tooth back of a liquid crystal display, and it deals in it.

[0050] Moreover, although the above explanation described the case where an acrylic was used as transparence resin used for a transparent material, a polycarbonate, polyurethane, polystyrene, silicone, etc. are sufficient.

[0051]

[Example]

The example of this invention is explained referring to [example 1] drawing 1 . The light source 1 (cold cathode discharge tube) which becomes one side of the transparent acrylic resin plate transparent material 3 which is an illumination side from a fluorescent lamp was stuck, and the polarization eliminator 7 which is a multilayer-structure object was combined in the edge light mold back light which forms the lamp cover 2 which consists of a reflector, and introduces light in a transparent material.

[0052] As the light source 1, it has the die length corresponding to the side-face length (152mm) of a 10 inch liquid crystal display side, and the cold cathode discharge tube of 10W with a thin tube diameter was used. Moreover, as a lamp cover 2, magnitude used the 160mmx220mmx5mm thing for the reflecting mirror of a cylindrical shape or an ellipse cartridge which wraps in a cold cathode discharge tube as a transparent material 3 with the translucency light guide plate made of acrylic resin (n= 1.5).

[0053] Furthermore, the phase contrast plate 4 was formed in the transparent material side face which counters the rear face and fluorescent lamp installation side of a transparent material 3, and the reflector which consists of aluminum metallic reflection film was formed on it.

[0054] The visual field selection film 6 irradiated and created ultraviolet rays into the mixture of polyether polyurethane acrylate (refractive index 1.481), TORIBUROMO phenoxy ethyl acrylate (refractive index 1.567), and a photopolymerization initiator. This film was installed on the transparent material 3. This film was a thing with an angle-of-visibility dependency almost like drawing 2 .

[0055] As a polarization eliminator 7, into the homogeneous transparence plastic sheet (n= 1.5), the height of the thickness direction adopted the configuration by which about about five layers of flat cellular layers with a radius of about several mm were distributed in the shape of a layer by about 10

micrometers, and equipped at the optical outgoing radiation side side of the visual field selection film 6.
[0056] Moreover, as a prism array 8, using the prism array of two equilateral triangles whose cross-section configurations are 58 degrees of vertical angles, it has arranged so that a vertical angle may face the polarization eliminator 7. The thickness of a prism array plate set the pitch of a prism array to about 1mm by 2mm. Furthermore, the diffusion plate 9 was used for the optical outgoing radiation side side of the prism array 7 in order to extend an angle of visibility.
[0057] As a liquid crystal cell 10, it is TN liquid crystal of a TFT drive, and the RGB color TFT drive TN liquid crystal display cel which has the number of pixels corresponding to VGA was used.
[0058] Abbreviation coincidence of the polarization shaft of the outgoing radiation light of the lighting system of this invention and the polarization shaft of a polarizing plate was carried out. The outgoing radiation side polarizing plate used the light absorption mold organic polarizing plate similarly. Although the sense of a polarization shaft was suitably chosen by the display mode (a normally white, normally black), in this example, it was a normally white display and the polarization shaft of the polarizing plate of an outgoing radiation side face was taken in the direction which 90-degree polarization shaft rotated to the polarization shaft of the polarizing plate of an incidence side face. The fluorescent lamp of 10W was used for the light source.
[0059] As an example of a comparison, it was the same as that of an example, and as a result of performing the case where a visual field selection film is not used, the example was 1.2 times as larger as the example of a comparison.
[0060] Although what replaced with the thing of an example 1 and formed the titanium oxide ($TiO2$:n=2.35) film in both the homogeneous front faces of a glass substrate (n= 1.52) further as a [example 2] deviation eliminator 7 was used, the bright lighting system was obtained like the example 1.
[0061]
[Effect of the Invention] By this invention, a liquid crystal display with the high use effectiveness of light and the lighting system suitable for it are obtained.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view having shown the example of this invention
[Drawing 2] The graph which shows the angle-of-visibility dependency of an angle-of-visibility selection film
[Drawing 3] The graph which shows the angular distribution of the outgoing radiation light of the conventional edge light mold back light
[Description of Notations]
1: The light source which consists of a fluorescent lamp

2: Lamp cover
3: Transparent material
4: Phase contrast plate
5: Reflector
6: Visual field selection film
7: Polarization eliminator
8: Prism array
9: Diffusion plate
10: Liquid crystal display component

[Translation done.]

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